

Keyboard Debounce and Real-Time Clock

Radio Shack®
TRS-80
MICRO
COMPUTER
SYSTEM

UTILITIES

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Required hardware:

KBFIX –

LEVEL II TRS-80

Video Display

Cassette Recorder

Real-Time Clock –

All the above plus Expansion Interface

Introduction

This cassette tape contains two machine-language programs to enhance the performance of your LEVEL II TRS-80. Side One contains KBFIX, a program to eliminate annoying "keybounce" — multiple entries when a single key is pressed. You'll probably want to load this short (55-byte) program each time you power-on the Computer.

(Keybounce is caused by contaminated or misadjusted key contacts. You can eliminate it by cleaning and adjusting each contact, but KBFIX is a much simpler solution.)

The second program (Side Two) has a more generalized application: it includes a relocating loader, RELO, followed by the special Debounce routine, plus a Real-Time Clock routine.

The relocating loader will let you select exactly where in memory you want to store the debounce and clock routines. This option will be important for machine-language programmers who may want to load the two programs into RAM addresses above or below other object code routines.

The Real-Time Clock routine enables the 25 mS heartbeat interrupt and updates certain memory locations, to provide a time-keeping facility which you can conveniently access from BASIC. The Real-Time Clock requires that an Expansion Interface be connected.

To load and use KBFIX (Keyboard Debounce routine)

Under LEVEL II BASIC

Load this program immediately after you power-on the Computer, before any other programs are loaded or typed in.

- 1) Turn on the Computer.
- 2) Answer the MEMORY SIZE? question as follows.

If your TRS-80 has ...	then type ...
4K	20424 ENTER
16K	32712 ENTER
32K	49096 ENTER
48K	65480 ENTER

- 3) Prepare the recorder to play the KBFIX side of the cassette.
- 4) Now type:

>SYSTEM **ENTER**

*? KBFIX **ENTER**

The tape will begin to load, and a pair of asterisks will blink on and off on the Display. If a C appears in place of one asterisk, there has been a loading error. Reload the tape, perhaps using a different volume setting.

- 5) When the first section of the tape has loaded, another *? will appear below the last line you typed in. Leave the recorder in the Play mode, and type:

*? / **ENTER**

The rest of the program will now load into high memory, and and

```
RELOCATION COMPLETE. BASE=XXC8READY  
>_
```

will appear on the Display, along with some other information which you can ignore for the time being (to understand it, read the description of RELO in this manual).

If there is an error during loading of the second part of the KBFIX program, the message BAD CASSETTE LOAD will be displayed. In this case, start over at step 1.

KBFIX

Once KBFIX has been loaded, it will remain in memory and will eliminate any keybounce. Typing the BASIC command NEW will have no effect on KBFIX; neither will the Reset button, unless you have an Expansion Interface connected. If you do, you'll need to reload KBFIX.

Note: KBFIX is designed to load into your LEVEL II TRS-80. It may not work in other LEVEL II units, and it may not work if different ROM chips are installed in your TRS-80 (during servicing, for example). However, RELO's Real-Time Clock will work in any LEVEL II computer with an Expansion Interface connected.

Under TRSDOS

KBFIX will work just as well under TRSDOS as under LEVEL II BASIC. However, you must first load the program under LEVEL II BASIC. Once the program is in memory, you can return to TRSDOS and dump it onto disk for convenient loading every time you power-up the system. After loading KBFIX from disk, you must activate it with the SYSTEM command in DISK BASIC.

To load KBFIX from tape:

- 1) IN THE DOS READY mode, type:

BASIC2 **ENTER**

The MEMORY SIZE? question will be displayed. Now follow the directions above, steps 2-5.

- 2) Press Reset. This will reload and re-initialize TRSDOS. Note that KBFIX is no longer activated, but the code is in memory. Just where it is in memory is determined by what MEMORY SIZE you typed in earlier.

If MEMORY SIZE? answer was ... Then KBFIX is stored at ...

(Decimal)	(Decimal)	(Hex)
32712	32713-32767	7FC9-7FFF
49096	49097-49151	BFC9-BFFF
65480	65481-65535	FFC9-FFFF

Now use the DUMP command to store the KBFIX routine on disk. For example, if you entered a MEMORY SIZE of 32712, then use :

DUMP KBFIX <START=X'7FC9', END=X'7FFF'>

Once you have saved the routine on disk, you can easily load and activate it as follows:

- 1) Under TRSDOS, type

```
LOAD KBFIX/CIM ENTER
```

This will put the routine into high memory.

- 2) Now type **BASIC** **ENTER**

Answer the FILES? question as desired, and answer the MEMORY SIZE? question exactly as you did when loading the routine from tape.

- 3) Now type:

```
>SYSTEM ENTER
```

```
*?/? starting address ENTER
```

where *starting address* is where KBFIX begins in memory (see the table above)

This will initialize KBFIX.

KBFIX will execute normally as long as you do not re-initialize the system, for example, by pressing Reset. In such a case, repeat steps 2-3 of the instructions immediately above for loading from disk.

How to load and use RELO

The Relocating Loader program (RELO) will let you load either or both of the special purpose routines — Keyboard Debounce and Real-Time Clock — wherever you specify in high memory. The Real-Time Clock routine requires that an Expansion Interface be connected.

Note to TRSDOS users:

This side of the tape (RELO plus modules) cannot be loaded under TRSDOS, since RELO would overlay (replace) part of the TRSDOS executive program. To implement the KBFIX routine, you should follow the procedure described above, "Using KBFIX under TRSDOS".

RELO—What it is

The Relocating Loader will let you load either or both of the special modules — KBFIX and Real-Time Clock — wherever you specify in high memory. In general, you'll want to load the routine(s) at the top of memory (highest numerical addresses) in your TRS-80 system.

However, suppose you already have a machine-language routine which occupies the last 100 bytes of RAM, and you want to load KBFIX and/or Real-Time Clock below this routine. RELO will let you do that.

You can also use RELO in conjunction with TBUG to create SYSTEM format tapes of the routines; these tapes will then load into the address you specified with RELO — so you don't have to relocate them each time they are loaded.

Note: All addresses from this point on are in hexadecimal, except where noted otherwise.

RELO is a SYSTEM format program which resides temporarily in RAM from 4980 through 4CFF (approximately). The sole purpose of RELO is to load the special-format "load modules", KBFIX and Real-Time Clock.

The special-format load modules consist of:

- A title block, which displays the module name on the screen
- A relocation directory, which tells RELO how big the relocatable code block is, and which addresses to modify when it is relocated
- The actual relocatable code block

How to use RELO

- 1) Turn on the TRS-80 and Expansion Interface, if connected.
- 2) Answer MEMORY SIZE? with a decimal address that leaves ample space in high RAM to accommodate all the machine-language routines you are going to load. KBFIX requires 55 bytes, and Real-Time Clock requires 79.
- 3) Prepare the Recorder to play the RELO side of the cassette.
- 4) Type:

>SYSTEM **ENTER**

*? RELO **ENTER**

RELO will begin to load.

- 5) After loading RELO successfully, the Computer will display another *? below the last line typed in. Type:

*?/ **ENTER**

The Display will read:

```
TRS-80 RELOCATING LOADER
BASE=nnnn
+
```

where *nnnn* is the highest hexadecimal address in your TRS-80, and

+ is the RELO prompt, telling you to enter a command

To take full advantage of the Relocating Loader, you need to understand what BASE means.

The BASE value determines where the next relocatable module (either KBFIX or Real-Time Clock) will be loaded. More specifically, the BASE address will contain the last byte of the next module you load.

For example, if BASE=7FFF, and you choose to load KBFIX, then KBFIX will be loaded from 7FC9 to 7FFF, and the new BASE would become 7FC8. This new BASE ensures that the next module you load will not overlay (replace) the KBFIX code.

When RELO is initialized, BASE is set to the highest address in your TRS-80.

RELO

RELO Commands

Whenever the + prompt appears alone as the last line on the Display, you can enter one of the following commands.

- S Search for the title of the next relocatable module
- L Load the module
- B Examine/modify the current BASE address. (Type B and the current base will be displayed. To leave it unchanged, press X. To change it, type in the new base and then press **ENTER** .)
- E Exit RELO and jump to LEVEL II command mode.
- R Restart the relocating loader and set the BASE to the highest address in memory.

Be careful to give commands at the appropriate time. For example, you should only use L after reading a title block — otherwise you'll get an INCORRECT LOAD MODULE TYPE message.

KBFIX Relocatable Module

KBFIX works by providing a patch to the LEVEL II keyboard scan routine. After the necessary code is loaded and relocated, the patch must be established to activate the routine. KBFIX will continue to operate until this patch is broken by a system re-initialization or by alteration of the code.

Here's a typical sequence for loading KBFIX, assuming you have a 16K TRS-80. For other memory configurations, the BASE addresses would be different; but the loading/activation sequence is the same.

- 1) Load RELO as described above, so that

```
TRS-80 RELOCATING LOADER  
BASE=7FFF  
+
```

is displayed.

- 2) Since BASE = top of memory, KBFIX will load into the highest 55 bytes of RAM. If you want it to load somewhere else, for example, 7000-7036, you'd type:

```
+B 7FFF 7036 ENTER
```

For this example, assume you left BASE=7FFF.

- 3) First you need to search for the KBFIX title block. Type:

+S

RELO will turn on the cassette, and read through the modules until it encounters the KBFIX title block.

```
KB DEBOUNCE ROUTINE
+
```

will be displayed. To load the KBFIX, type L.

```
LOADING RELOCATION DIRECTORY
LOADING RELOCATABLE CODE
RELOCATION COMPLETE  BASE=7FC8
+
```

will be displayed.

Note the BASE value on paper. You will need it in step 5 below.

- 4) You can now return to BASIC by typing the letter E, or you can first load the Real-Time Clock routine (see Real-Time Clock for details). Let's assume you returned to BASIC by typing E.
- 5) To activate KBFIX, you must use the SYSTEM command to jump to the starting address of KBFIX. To determine this address, add one (1) to the BASE value which was displayed after KBFIX was loaded. This will give you the starting address of KBFIX.

In our example, we'd jump to 7FC9 hexadecimal, or 32713 decimal. To accomplish this jump, type:

```
>SYSTEM ENTER
```

```
*?/32713 ENTER
```

BASIC will respond with

```
READY
>
```

and KBFIX is operational.

RELO

Real-Time Clock Module

Note: The Real-Time Clock routine cannot be used under TRSDOS (use the TRSDOS clock!)

This module is located after KBFIX on the RELO side of the cassette. For the purpose of this example, let's assume you have loaded KBFIX from address 7FC9-7FFF (steps 1-4 above), and instead of returning to BASIC, you first want to load the Real-Time Clock module.

The last two display lines show:

```
RELOCATION COMPLETE.  BASE=7FC8  
+
```

First you must search for the title block of the next module. So type the letter S. When

```
REAL-TIME CLOCK  
+
```

is displayed, type the letter L to load it. (If another KBFIX title block is displayed, type S again to search through to the next title block.)

During loading and relocation of the Real-Time Clock, the display will read:

```
LOADING RELOCATION DIRECTORY  
LOADING RELOCATABLE CODE  
RELOCATION COMPLETE.  BASE=7F7A  
+
```

Make a note of the last BASE value – you'll need it to activate the routine later.

Type E to return to BASIC.

Activate KBFIX as explained on page 7, then continue on page 9.

To activate and access the Real-Time Clock:

- 1) The routine is activated by execution of a USR call to the starting address. Add one to the last BASE value displayed after loading the clock routine; this is the start address. In the example above, the starting address is $7F7A+1 = 7F7B$.

Now split the address into two bytes: least significant (lsb) and most significant (msb). In our example, 7F7B is split into

7B (lsb) = 123 decimal
7F (msb) = 127 decimal.

- 2) Now type in the following BASIC program to demonstrate how to set the time, start the clock, and read it.

```

10 CLS: INPUT"ENTER THE TIME (HRS, MINS, SECS)"; H%, M%, S%
20 POKE 16481, H%; POKE 16480, M%; POKE 16479, S% 'SET TIME
30 POKE 16526, 123 'SET UP LSB FOR USR CALL
40 POKE 16527, 127 'SET UP MSB FOR USR CALL
50 X=USR(1) 'START CLOCK
60 '          HOURS      :      MINUTES      :      SECONDS
70 PRINT@400, PEEK(16481); " " PEEK(16480); " " PEEK(16479)
80 GOTO 70

```

Line 30 activates the clock routine. In detail, it links an interrupt service routine that enables the interrupt process, establishes the correct interrupt mode, and forms the necessary counting functions to increment seconds, minutes and hours properly.

Once enabled, the clock will continue to run until the interrupt is disabled or the code is altered. For example, if you **BREAK** the above program for a few minutes, then type **CONT** **ENTER** , you'll notice that the clock is still correct.

Some special cautions are required when using the clock routine:

- Before doing any cassette input/output operation, you must disable the clock. This is simply accomplished by executing the statement:

```
X=USR(0)
```

To re-enable the clock, execute the statement:

```
X=USR(1)
```

- The hours count does not re-cycle to zero after 12 or 24 hours. Your program should check the hours count when it is incremented, and re-set it as desired.

Making SYSTEM tapes of the Modules

After you've relocated KBFIX and Real-Time Clock to suit your needs, you might like to save these custom-located routines so you can load them directly via the SYSTEM command. It's easy to do this, using the TBUG monitor program, Radio Shack Catalog Number 26-2001.

- 1) Use RELO to locate KBFIX and/or Real-Time Clock as desired.
- 2) Return to BASIC, and load TBUG as explained in the TBUG manual.
- 3) Use the TBUG P-command to create SYSTEM tapes of KBFIX and Real-Time Clock. For example, if you loaded both routines as described above, you could use the following TBUG commands:

```
# P 7FC9 7FFF KBFIX ENTER  
and  
# P 7F7B 7FC8 CLOCK ENTER
```

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NOTE: Good data processing procedure dictates that the user test the program, run and test sample sets of data, and run the system in parallel with the system previously in use for a period of time adequate to insure that results of operation of the computer or program are satisfactory.

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